Taxon: Myroxylon balsamum (L.) Harms **Family:** Fabaceae

Common Name(s): balsam of Peru
balsam of Tolu
Peru balsam

Synonym(s): Myrospermum pereirae Royle
Myrospermum toluiferum (A. Rich.) DC
Myroxylon balsamum var. punctatum (Klotzsch) L.
Myroxylon punctatum Klotzsch
Toluifera balsamum L.
Toluifera pereirae (Royle) Baill.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 16 Oct 2019

WRA Score: 8.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Tropical Tree, Environmental Weed, Shade-Tolerant, Dense Stands, Wind-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	n
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed		
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals		
405	Toxic to animals		
406	Host for recognized pests and pathogens		

Qsn #	Question	Answer Option	Answer
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	y
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	>3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Panda, H. (2005). Cultivation and Utilization of Aromatic Plants. Asia Pacific Business Press, Inc., Delhi, India	"A Colombian tree once cultivated by the Incas for its vanilla--like fragrance and medicine." [But no evidence of domestication substantially modifying wild type]

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. (2019). Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2019). Personal Communication	NA

Qsn #	Question	Answer
201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	Chudnoff, M. (1984). Tropical Timbers of the World. Agriculture Handbook Number 607. USDA Forest Service, Washington, D.C.	"Distribution: Has a wide range from southern Mexico southward through Central American and continuing to Argentina."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Latitude between 20°N and 25°S"
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 16 Oct 2019]	"Native Northern America SOUTHERN MEXICO: Mexico [Campeche, Chiapas, Guerrero, Jalisco, Michoacán de Ocampo, Morelos, Oaxaca, Tabasco, Veracruz de Ignacio de la Llave, Yucatán] Southern America CARIBBEAN: Cuba CENTRAL AMERICA: Belize, [Cayo] Costa Rica, [Puntarenas, San José] El Salvador, [La Libertad, San Salvador, Sonsonate] Guatemala, [Petén] Honduras, [Comayagua, El Paraíso] Nicaragua, Panama [Darién] NORTHERN SOUTH AMERICA: Guyana, Venezuela [Carabobo, Falcon, Miranda, Yaracuy, Zulia] BRAZIL: Brazil [Acre, Pará] WESTERN SOUTH AMERICA: Bolivia, [El Beni] Colombia, [Antioquia, Bolívar, Boyacá, Magdalena, Meta, Cesar, Amazonas] Ecuador, [El Oro, Napo, Pastaza, Zamora Chinchipe] Peru [Amazonas, Arequipa, Cusco, Huánuco, Madre de Dios, Pasco, San Martín, Tumbes, Ucayali]"
	Duke, J.A. & DuCellier, J.L.. (1993). CRC Handbook of Alternative Cash Crops. CRC Press, Boca Raton, FL	"Ranging from Subtropical Dry to Wet through Tropical Dry Forest Life Zones...Trees grow wild, scattered in forests of northern South America"

202	Quality of climate match data	High
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 16 Oct 2019]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	- Altitude range: 300 - 700 m - Mean annual rainfall: 1350 - 4050 mm - Rainfall regime: summer; uniform - Mean annual temperature: 23 - 27ºC

Qsn #	Question	Answer
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 16 Oct 2019]	"M. balsamum grows in areas with annual precipitation ranging from 1 350-4 030 mm (mean 2 640 mm), annual mean temp of 27-32 deg C, and soils with mildly acidic pH."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Latitude between 20°N and 25°S "
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 16 Oct 2019]	"Native Northern America SOUTHERN MEXICO: Mexico [Campeche, Chiapas, Guerrero, Jalisco, Michoacán de Ocampo, Morelos, Oaxaca, Tabasco, Veracruz de Ignacio de la Llave, Yucatán] Southern America CARIBBEAN: Cuba CENTRAL AMERICA: Belize, [Cayo] Costa Rica, [Puntarenas, San José] El Salvador, [La Libertad, San Salvador, Sonsonate] Guatemala, [Petén] Honduras, [Comayagua, El Paraíso] Nicaragua, Panama [Darién] NORTHERN SOUTH AMERICA: Guyana, Venezuela [Carabobo, Falcon, Miranda, Yaracuy, Zulia] BRAZIL: Brazil [Acre, Pará] WESTERN SOUTH AMERICA: Bolivia, [El Beni] Colombia, [Antioquia, Bolívar, Boyacá, Magdalena, Meta, Cesar, Amazonas] Ecuador, [El Oro, Napo, Pastaza, Zamora Chinchipe] Peru [Amazonas, Arequipa, Cusco, Huánuco, Madre de Dios, Pasco, San Martín, Tumbes, Ucayali]"
	Duke, J.A. & DuCellier, J.L.. (1993). CRC Handbook of Alternative Cash Crops. CRC Press, Boca Raton, FL	"Ranging from Subtropical Dry to Wet through Tropical Dry Forest Life Zones...Trees grow wild, scattered in forests of northern South America"
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Listed as naturalized and/or invasive in a number of locations worldwide] "References: Federated States of Micronesia-N-230, Sri Lanka-E-268, Sri Lanka-EI-627, Caribbean-N-707, Global-N-714, United States of America-Q-1197, Caribbean-N-1201, Global-W-1376, Global-I-1404, Cuba-W-1977, Democratic Republic of the Congo-W-1977, Ghana-W-1977, India-W-1977, Marshall Islands-W-1977, Micronesia (Federated States of)-W-1977, Sierra Leone-W-1977, Sri Lanka-W-1977, Uganda-W-1977, Global--1324."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops, Volume 4. Springer-Verlag, Berlin, Heidelberg, New York	"Cultivation experiments with the Peru balsam tree began since the last century in several African, Asiatic countries and in Surinam, but were mostly unsuccessful."

Qsn #	Question	Answer
	Skolmen, R.G. 1980. Plantings on the forest reserves of Hawaii: 1910–1960. Institute of Pacific Islands Forestry, Pacific Southwest Forest & Range Experiment Station, US Forest Service, Honolulu, HI	A total of 970 trees were planted on the Hawaiian Islands of Oahu and Hawaii between the years of 1928 to 1935. The majority (966) were planted on Oahu, and only 4 reported on the island of Hawaii.
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	India; Africa, Congo Democratic Republic, Tanzania, Uganda; Trinidad and Tobago, Florida, [Australia], Queensland [planted]
	Imada, C.T., Staples, G.W. & Herbst, D.R. 2005. Annotated Checklist of Cultivated Plants of Hawai'i. http://www2.bishopmuseum.org/HBS/botany/cultivatedplants/. [Accessed 16 Oct 2019]	Myroxylon balsamum (Linnaeus) Harms (Confirmed) Synonyms: Syn. Myroxylon toluiferum (Linnaeus) Kunth Common Names: Balsam-of-Tolu, Tolu, Balsam tree First Collected: 1924 Locations: Harold L. Lyon Arboretum; Waimea Arboretum & Botanical Garden

301	Naturalized beyond native range	y
	Source(s)	**Notes**
	Francis, J.K. & Liogier, H.A. 1991. Naturalized Exotic Tree Species in Puerto Rico. General Technical Report SO-82. United States Department of Agriculture Forest Service, New Orleans, LA	"Table 1-Naturalized and escaped exotic trees in Puerto Rico" [Myroxylon balsamum - One site in Cupey Alto; less than 1000 plants [2 = Slow spread and abundant reproduction, I = Infrequent or confined to limited habitat (less than 100 hectares),]
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[Listed as naturalized and/or invasive in a number of locations worldwide] "References: Federated States of Micronesia-N-230, Sri Lanka-E-268, Sri Lanka-EI-627, Caribbean-N-707, Global-N-714, United States of America-Q-1197, Caribbean-N-1201, Global-W-1376, Global-I 1404, Cuba-W-1977, Democratic Republic of the Congo-W-1977, Ghana-W-1977, India-W 1977, Marshall Islands-W-1977, Micronesia (Federated States of)-W-1977, Sierra Leone-W 1977, Sri Lanka-W-1977, Uganda-W-1977, Global--1324."
	Pallewatta, N., J.K. Reaser, and A.T. Gutierrez. (eds.). (2003). Invasive Alien Species in South-Southeast Asia: National Reports & Directory of Resources. Global Invasive Species Programme, Cape Town, South Africa	[Naturalized and invasive in Sri Lanka] "Myroxylon balsamum was introduced to the Central Province as a windbreak species and has now developed into monospecific stands covering a large extent of Udawattekele Nature Reserve in the Kandy district (Wedatanthri & Hitinayake, 1999; Hitinayake et al., 2000; Pushpakumara et al., 2000)."
	Wagner, W.L., Herbst, D.R.& Lorence, D.H. (2019). Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/. [Accessed 16 Oct 2019]	No evidence in the Hawaiian Islands to date

302	Garden/amenity/disturbance weed	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Marambe, B. (2002). Invasive alien species in insular South Asia. Pp. 51-54 in N. Pallewatta, J. K. Reaser, and A. T. Gutierrez (eds.). Prevention and Management of Invasive Alien Species: Proceedings of a Workshop on Forging Cooperation throughout South and Southeast Asia. 14-16 August 2002 Bangkok, Thailand	[Environmental weed. See 3.04] "Examples of invasive weed species in Sri Lanka include: water fern Salvinia molesta, water hyacinth Eichhornia crassipes, giant sensitive plant Mimosa pigra, congress weed Parthenium hysterophorus, lantana Lantana camara, balsam of Peru Myroxylon balsamum, gorse weed Ulex europaeus, mesquite Prosopis juliflora, alligator weed Alternanthera philoxeroides, Ipil-ipil Leucaena leucocephala, madeira vine Anredera cordifolia, and wild sunflower Tithonia diversifolia. Among the faunal populations, feral buffalo Bubalus bubalis, tank cleaner Hypostomus plecostomus, clown knife fish Chitala chitala, and tilapia Sarotherodon mossambicus are among the dominant IAS in recorded in the country"

303	Agricultural/forestry/horticultural weed	n
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

304	Environmental weed	y
	Source(s)	**Notes**
	Weerawardane, N.D.R. & Dissanayake, J. (2005). Status of forest invasive species in Sri Lanka. In McKenzie, P., Brown C., Jianghua, S. & Jian, W. (eds.). The unwelcome guests Proceedings of the Asia-Pacific Forest Invasive Species Conference. Kunming, Yunnan Province, China 17 - 23 August 2003. FAO, Bangkok	"First reported in the 1920s, Myroxylon has recently been identified as colonizing natural and seminatural habitats in some parts of the country. It has been planted as a shade tree along roadsides, as windbreaks and in plantations. It has been reported to damage the composition, structure and functions of natural ecosystems. In certain forests, it has developed into mono-specific stands, for example, in Udawattakele Nature Reserve and in some mixed mahogany forests."
	Pallewatta, N., J.K. Reaser, and A.T. Gutierrez. (eds.). (2003). Invasive Alien Species in South-Southeast Asia: National Reports & Directory of Resources. Global Invasive Species Programme, Cape Town, South Africa	"Myroxylon balsamum was introduced to the Central Province as a windbreak species and has now developed into monospecific stands covering a large extent of Udawattekele Nature Reserve in the Kandy district (Wedatanthri & Hitinayake, 1999; Hitinayake et al., 2000; Pushpakumara et al., 2000)."
	Wedathanthri, H. P., & Hitinayake, H. M. G. S. B. (1999). Invasive behaviour of Myroxylon balsamum at Udawattakele forest reserve. In Proceedings of International Forestry and Environment Symposium. University of Sri Jayewardenepura, Nugegoda, Sri Lanka	"Results showed that Myroxylon has dominated the understory even when a few mother plants were available in the overstory. This could be attributed to prolific seed production capacity, its ability to germinate under wide range of light conditions, favourable micro-climatic conditions presenting in the understory and absence of any seed pest or pathogen. Further results clearly showed that Myroxylon invasion had resulted in the decline of species diversity of the forest. If no control measures are applied, there is a possibility that this species could invade the other parts of the forest in the long term. Therefore necessary action must be taken immediately to control Myroxylon balsamum. This could be done by uprooting seedlings, collecting and destroying seeds and thinning some mother trees. Further understanding of the efficiency of key physiological processes of Myroxylon including water use efficiency and stomatal conductance could be useful in deciding measures to control the invasion."

Qsn #	Question	Answer
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	[Myroxylon dominates the understory and reduces species diversity in the forest] "The objective of this study was to estimate the changes in the vegetation structure and species composition of the Udawattakele forest reserve due to Myroxylon balsamum invasion during the twelve year period from 1998 to 2010. Species composition of the upper story and under story were evaluated through measuring Relative Importance Value (RIV) of species in the Myroxylon invaded parts of the forest, initially in 1998 and then in 2010. A map was drawn to show the distribution and abundance of Myroxylon in the Udawattakele forest reserve. Germination of Myroxylon seeds were evaluated under different light intensities. Results showed that seeds of Myroxylon are able to germinate under a wide range of conditions from full sunlight to complete darkness. The results of the forest inventory showed that Myroxylon invasion has caused significant reduction in the species diversity in the forest. Myroxylon dominates the under story even when a few mother trees occur in the over story due to its prolific self-regenerating ability. Further, it was found that, Myroxylon had infested some new areas of the forest during the 12 year period between 1998-2010. Hence control measures have to be applied without any delay. The over story species composition and diversity of the Myroxylon invaded areas of the forest has not changed significantly (P=0.05) during the 12 year period. However, species diversity of the under story has increased (P=0.05). This was caused mainly due to self-thinning of Myroxylon and arrival of Mahogany, another species spreading rapidly in the Udawattakele forest reserve."

305	Congeneric weed	
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Myroxylon pereirae and Myroxylon toluiferum are listed as weeds, but are also listed as synonyms of Myroxylon balsamum. Myroxylon peruiferum is listed as a weed, but impacts have not been verified.

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Sartori, Â, Lewis, G., De Freitas Mansano, V., & De Azevedo Tozzi, A. (2015). A revision of the genus Myroxylon (Leguminosae: Papilionoideae). Kew Bulletin, 70(4), 1-12	[No evidence] "Tree (8 -) 15 - 50 m tall. Leaves 5 -11-foliolate, petiole, rachis and petiolules sparsely ferruginous-tomentose; petiole 1- 2.7 cm long; rachis 2. 7 - 12 (- 17) cm long; petiolules 2 - 6 mm long; leaflets 5.5 - 10. 5 x 2 - 5 cm, oblong to elliptic, apex acuminate or long-acuminate, base attenuate or rounded, terminal leaflets elliptic to rhombic, the lower pairs ovate, margin sinuous, entire, concolorous or discolorous, both surfaces glabrous or sparsely sericeous on the blade and midrib, adaxial surface dull (not shiny), veins prominent on both surfaces, pellucid dots and streaks inconspicuous unless leaflet held up to the light."

402	Allelopathic	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"Myroxylon balsamum is often used to shade coffee plantations, where it attains a height of 10 m in 10 to 12 years, and 20 m in 25 years." [Suggests tree is not allelopathic to coffee]
	Fujii, Y., Parvez, S. S., Parvez, M., Ohmae, Y., & Iida, O. 2003. Screening of 239 medicinal plant species for allelopathic activity using the sandwich method. Weed Biology and Management, 3(4): 233-241	"Table 1. Screening of leaf litter of 239 medicinal plant species under different families using the sandwich method" [Myroxylon balsamum extracts were evaluated for their allelopathic effects on lettuce seeds. Results were not significant]
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The presence of high levels of coumarin in the cotyledons and embryonic axis seems to have no effect on the germination of this species, but it seems to act as an allelopathic factor. The emergence of the seedlings takes 15-30 days, and they may be planted out after 6 months." [No further information found on allelopathic properties]

403	Parasitic	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. balsamum is a deciduous tree, shade tolerant, which can reach 34 m in height, with bole up to 15 m and a d.b.h. of up to 100 cm." [Fabaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**
	Perera, N. F. & Perera, E. R. K. (2000). Economic importance of invasive plant species. Sixth Annual Symposium of the Department of Forestry and Environmental Science, Sri Lanka. 15-16 December 2000, Kandy, Sri Lanka. University of Sri Jayewardenepura, Nugegoda, Sri Lanka	"For example, Tithonia diversifolia (wild sunflower) Panicum maximum (guinea grass), Pennisetum clandestinum (kikin grass) Prosopis juliflora, Lantana camara, Eichchornia crassipes (water hyacinth) and Myroxylon balsamum (Kattakumanchal) provide multiple uses such as cattle feed, fodder, green manure, biopesticides and phyto extractants." [Palatability unknown; use as cattle feed and fodder may be referring to other species]
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	Unknown. Fodder not listed among uses

405	Toxic to animals	
	Source(s)	**Notes**
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Can cause an allergic reaction in some individuals. Resin balsam febrifuge, Stimulant, expectorant, antiseptic, parasiticide, an external cicatrizant, effective for colds, abscesses, rheumatism, venereal diseases, asthma, bronchitis, catarrh and lung ailments." [Unknown if chemicals in plants can affect animals]

Qsn #	Question	Answer
406	**Host for recognized pests and pathogens**	
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Pests recorded Fungus diseases: Meliola xylosmae Myiocopron pereirae Peckia pereirae Phomopsis"

407	**Causes allergies or is otherwise toxic to humans**	
	Source(s)	**Notes**
	Duke, J.A. (2008). Duke's Handbook of Medicinal Plants of Latin America. CRC Press, Boca Raton, FL	"As of 2007, the FDA Poisonous Plant Database listed one title alluding to toxicity of this species" [No further details]
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The tree is also well known for its yield of balsam, extracted from the trunk, which is used in perfumes and medicine."
	Physicians Desk Reference. (2000). The PDR family guide to natural medicines and healing therapies. Random House, Inc. New York, New York	"Used externally, Balsam of Peru often causes skin reactions such as eruptions, ulcers, swelling, and red patches. Allergic reactions are also possible from internal use. Because Balsam of Peru may increase your sensitivity to sunlight, minimize your exposure to the sun while using this medication." [Allergic reactions caused by intentional application or ingestion of resin from cut bark]
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Potentially] "Can cause an allergic reaction in some individuals. Resin balsam febrifuge, Stimulant, expectorant, antiseptic, parasiticide, an external cicatrizant, effective for colds, abscesses, rheumatism, venereal diseases, asthma, bronchitis, catarrh and lung ailments."

408	**Creates a fire hazard in natural ecosystems**	**n**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. balsamum is a deciduous tree, shade tolerant, which can reach 34 m in height, with bole up to 15 m and a d.b.h. of up to 100 cm...In Brazil M. balsamum grows throughout most of the whole country, mainly in the semideciduous forest of the river Parana's basin and tropical dense rain forest (Amazon forest and Atlantic forest)." [No evidence. Occurs in wet forests]
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The species is found in evergreen tropical humid forests in low to medium elevations from 100 to 600 m." [Unlikely, given its distribution primarily in wetter forests]

409	**Is a shade tolerant plant at some stage of its life cycle**	**y**
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"Germination of Myroxylon seeds were evaluated under different light intensities. Results showed that seeds of Myroxylon are able to germinate under a wide range of conditions from full sunlight to complete darkness."

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. balsamum is a deciduous tree, shade tolerant, which can reach 34 m in height, with bole up to 15 m and a d.b.h. of up to 100 cm...In Brazil M. balsamum grows throughout most of the whole country, mainly in the semideciduous forest of the river Parana's basin and tropical dense rain forest (Amazon forest and Atlantic forest)...- Tolerates shade - Ability to fix nitrogen"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"It is indifferent with relationship to the physical conditions of the soil, preferring well drained soils. Soil descriptors - Soil texture: light; medium; heavy - Soil drainage: free - Soil reaction: acid; neutral; alkaline"
	Orwa C,, Mutua, A., Kindt R., Jamnadass, R, & Anthony, S. 2009 Agroforestree Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org. [Accessed 16 Oct 2019]	"Soil type: Grows on soils with pH 5-8."

411	Climbing or smothering growth habit	n
	Source(s)	**Notes**
	Sartori, Â, Lewis, G., De Freitas Mansano, V., & De Azevedo Tozzi, A. (2015). A revision of the genus Myroxylon (Leguminosae: Papilionoideae). Kew Bulletin, 70(4), 1-12	"Tree (8 -) 15 - 50 m tall."

412	Forms dense thickets	y
	Source(s)	**Notes**
	Pallewatta, N., J.K. Reaser, and A.T. Gutierrez. (eds.). (2003). Invasive Alien Species in South-Southeast Asia: National Reports & Directory of Resources. Global Invasive Species Programme, Cape Town, South Africa	"Table 1. Invasive alien plants reported from Sri Lanka...Myroxylon balsamum was introduced to the Central Province as a windbreak species and has now developed into monospecific stands covering a large extent of Udawattekele Nature Reserve in the Kandy district (Wedatanthri & Hitinayake, 1999; Hitinayake et al., 2000; Pushpakumara et al., 2000)."

501	Aquatic	n
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[Terrestrial] "M. balsamum is a deciduous tree, shade tolerant, which can reach 34 m in height, with bole up to 15 m and a d.b.h. of up to 100 cm."
	Sartori, Â, Lewis, G., De Freitas Mansano, V., & De Azevedo Tozzi, A. (2015). A revision of the genus Myroxylon (Leguminosae: Papilionoideae). Kew Bulletin, 70(4), 1-12	[Terrestrial] "The specie s is fairly common in tropical forest at 200 - 690 m altitude . In Peru and Brazil the specie s is mostly associate d with rivers, and some time s grows on lateritic soil."

Qsn #	Question	Answer
502	**Grass**	**n**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"- Ability to fix nitrogen"
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 16 Oct 2019]	Family: Fabaceae (alt.Leguminosae) Subfamily: Faboideae Tribe: Sophoreae

Qsn #	Question	Answer
503	**Nitrogen fixing woody plant**	**y**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"- Ability to fix nitrogen"
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 16 Oct 2019]	Family: Fabaceae (alt.Leguminosae) Subfamily: Faboideae Tribe: Sophoreae

Qsn #	Question	Answer
504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**n**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. balsamum is a deciduous tree, shade tolerant, which can reach 34 m in height, with bole up to 15 m and a d.b.h. of up to 100 cm."

Qsn #	Question	Answer
601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"In Brazil flowering occurs from July to September and the fruits ripen from October to November. The fruit is a samara and 1 kilogram contains about 1600 fruits."
	Sartori, Â, Lewis, G., De Freitas Mansano, V., & De Azevedo Tozzi, A. (2015). A revision of the genus Myroxylon (Leguminosae: Papilionoideae). Kew Bulletin, 70(4), 1-12	[No evidence] "The specie s is fairly common in tropical forest at 200 - 690 m altitude . In Peru and Brazil the specie s is mostly associate d with rivers, and some time s grows on lateritic soil."

Qsn #	Question	Answer
602	**Produces viable seed**	**y**
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"Germination of Myroxylon seeds were evaluated under different light intensities. Results showed that seeds of Myroxylon are able to germinate under a wide range of conditions from full sunlight to complete darkness."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Stand establishment using natural regeneration; planting stock"
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The species is reproduced by seed. Seed behavior is orthodox. Germination is hypogeal and seedlings are cryptocotylar."

603	**Hybridizes naturally**	
	Source(s)	**Notes**
	WRA Specialist. (2019). Personal Communication	Unknown. No evidence found

604	**Self-compatible or apomictic**	**y**
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"Flowers are self-pollinated (Dasanayake and Fosberg, 1983)."

605	**Requires specialist pollinators**	**n**
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"Flowering season of Myroxylon is from July to September every year. Flowers are self-pollinated (Dasanayake and Fosberg, 1983). Pods are lance (samara) shaped."
	Tucker, S. C. (1993). Floral ontogeny in Sophoreae (Leguminosae: Papilionoideae). I. Myroxylon (Myroxylon group) and Castanospermum (Angylocalyx group). American Journal of Botany, 80(1), 65-75	"In both, large flower size, exserted stamens, and hypanthium are adaptations to bird-pollination" [No indication that bird pollination limits seed set]

606	**Reproduction by vegetative fragmentation**	**n**
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"Stand establishment using natural regeneration; planting stock" [No indication of suckering or vegetative spread]
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The species is reproduced by seed. Seed behavior is orthodox. Germination is hypogeal and seedlings are cryptocotylar."

607	**Minimum generative time (years)**	**>3**

Qsn #	Question	Answer
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. balsamum generally has slow growth in the field. In experimental planting in southern Minas Gerais (Brazil), at spacings of 1.5 x 3 m, the species reached height of 0.44 m and 0.72 m after 27 months, at two different sites. In western Minas Gerais, in more fertile soils, at spacing of 3 x 3 m, it reaches a height of 2.27 m with a d.b.h. of 1.4 cm after 36 months. In Sao Paulo State, in spacing 2 x 2 m, it reaches 7.5 m in height with a d.b.h. of 6.2 cm at 14 years."
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"Myroxylon balsamum is a slow-growing, large tree that reaches up to 45 m in height and 1m d.b.h...Flowering begins after 5 years and occurs February through June. The flowers are whitish, pubescent, medium-sized, entomophilous, and grouped in simple axillary or terminal racemes 20 cm long."

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**n**
	Source(s)	**Notes**
	Croat, T.B. 1978. Flora of Barro Colorado Island. Stanford University Press, Stanford, CA	"Other species with wind dispersed seeds include Dalbergia retusa, Myroxylon balsamum... "
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The fruit is a flat, indehiscent, samaroid, winged pod that is stipitate, narrowly obovate, 7 to 11 cm long, and 2 cm wide; it narrows toward the base. The pod wings mimic seeds; they are up to 8 cm long and 1 to 2 cm wide and have many veins crowded submedially; the lower wing is narrower than the upper wing. The fruit is monochrome yellowish brown when dried. Fruit dispersal is anemochorous. Dry fruits are found on the ground November to January." [No means of external attachment]

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"A few specimens of Balsam-of-Tolu, Myroxylon balsamum (Linnaeus) Harms, can be found in schoolyards, former estates, and parks around O'ahu."
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. balsamum is used as an ornamental, for restoration of protection forests, and reclamation of degraded land. This species is also used in El Salvador in agroforestry systems as a shade tree in coffee plantations."

703	**Propagules likely to disperse as a produce contaminant**	**n**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The fruit is a flat, indehiscent, samaroid, winged pod that is stipitate, narrowly obovate, 7 to 11 cm long, and 2 cm wide; it narrows toward the base. The pod wings mimic seeds; they are up to 8 cm long and 1 to 2 cm wide and have many veins crowded submedially; the lower wing is narrower than the upper wing. The fruit is monochrome yellowish brown when dried. Fruit dispersal is anemochorous. Dry fruits are found on the ground November to January...The apical seminiferous area is turgid and has one subreniform seed that is 15 to 18 mm long." [No evidence, and fruits/seeds relatively large]

704	Propagules adapted to wind dispersal	y
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"Flowering season of Myroxylon is from July to September every year. Flowers are self-pollinated (Dasanayake and Fosberg, 1983). Pods are lance (samara) shaped. These winged indehiscent fruits are straw coloured when ripened. After ripening pods are dispersed with the aid of wind and runoff water."
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The fruit is a flat, indehiscent, samaroid, winged pod that is stipitate, narrowly obovate, 7 to 11 cm long, and 2 cm wide; it narrows toward the base. The pod wings mimic seeds; they are up to 8 cm long and 1 to 2 cm wide and have many veins crowded submedially; the lower wing is narrower than the upper wing. The fruit is monochrome yellowish brown when dried. Fruit dispersal is anemochorous. Dry fruits are found on the ground November to January."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"Flowering season of Myroxylon is from July to September every year. Flowers are self-pollinated (Dasanayake and Fosberg, 1983). Pods are lance (samara) shaped. These winged indehiscent fruits are straw coloured when ripened. After ripening pods are dispersed with the aid of wind and runoff water."

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"These winged indehiscent fruits are straw coloured when ripened. After ripening pods are dispersed with the aid of wind and runoff water."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The fruit is a flat, indehiscent, samaroid, winged pod that is stipitate, narrowly obovate, 7 to 11 cm long, and 2 cm wide; it narrows toward the base. The pod wings mimic seeds; they are up to 8 cm long and 1 to 2 cm wide and have many veins crowded submedially; the lower wing is narrower than the upper wing. The fruit is monochrome yellowish brown when dried. Fruit dispersal is anemochorous. Dry fruits are found on the ground November to January." [No means of external attachment]
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"These winged indehiscent fruits are straw coloured when ripened. After ripening pods are dispersed with the aid of wind and runoff water."

708	Propagules survive passage through the gut	n
	Source(s)	**Notes**
	Hitinayake, G., Gunawardane, V. & Wedathanthri, H. (2016). Long-term study on invasive behavior of Myroxylon balsamum in the Udawattakele forest reserve, Kandy, Sri Lanka. Journal of Biodiversity and Environmental Sciences 9(4): 262-271	"These winged indehiscent fruits are straw coloured when ripened. After ripening pods are dispersed with the aid of wind and runoff water." [No indication that pods or seeds are ingested or dispersed intact]

801	Prolific seed production (>1000/m2)	
	Source(s)	**Notes**
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"M. balsamum is a deciduous tree, shade tolerant, which can reach 34 m in height, with bole up to 15 m and a d.b.h. of up to 100 cm." [Can reach fairly large size, but unknown what densities of seeds can be produced]

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	**Notes**
	Vozzo, J.A. 2002. Tropical Tree Seed Manual. USDA Forest Service, Washington, D.C.	"The fruit is a flat, indehiscent, samaroid, winged pod that is stipitate, narrowly obovate, 7 to 11 cm long, and 2 cm wide; it narrows toward the base. The pod wings mimic seeds; they are up to 8 cm long and 1 to 2 cm wide and have many veins crowded submedially; the lower wing is narrower than the upper wing. The fruit is monochrome yellowish brown when dried. Fruit dispersal is anemochorous. Dry fruits are found on the ground November to January...Fruits must be soaked in running water for 24 hours to soften the pericarp and facilitate seed extraction. The species is reproduced by seed. Seed behavior is orthodox. Germination is hypogeal and seedlings are cryptocotylar." [No information on seed longevity under natural conditions]

803	Well controlled by herbicides	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"M. balsamum was one of several weeds of managed grasslands in Brazil that underwent herbicide trials in the early 1960s; basal applications of a 1.5% solution of a 2,4-D + 2,4,5-T mixture gave better control than did spraying overall (Vageler, 1962)."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	
	Source(s)	**Notes**
	CABI. (2019). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Unknown if plants can resprout after cutting] "Wedathanthri and Hitinayake (1999) recommended physical control measures for M. balsamum in central Sri Lanka, including uprooting seedlings, collecting and destroying seeds, and thinning some mature trees."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. (2019). Personal Communication	Unknown. Cultivated in the Hawaiian Islands. No records of naturalization

Summary of Risk Traits:

High Risk / Undesirable Traits
• Thrives in tropical climates
• Naturalized in Puerto Rico, Sri Lanka and elsewhere (but no evidence in the Hawaiian Islands to date)
• An environmental weed in Sri Lanka, reducing diversity in native forest
• Resin can cause an allergic reaction
• Shade-tolerant
• Tolerates many soil types
• Forms monotypic stands in Sri Lanka
• N-fixing (can modify soil chemistry)
• Reproduces by seeds
• Self-pollinating
• Seeds dispersed by wind, water and intentionally by people

Low Risk Traits
• Unarmed (no spines, thorns, or burrs)
• Ornamental
• Not reported to spread vegetatively
• Reaches maturity in 5+ years
• Herbicides may provide effective control